Modeling and Simulation in Support of HiCASS System Development

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Crystal City
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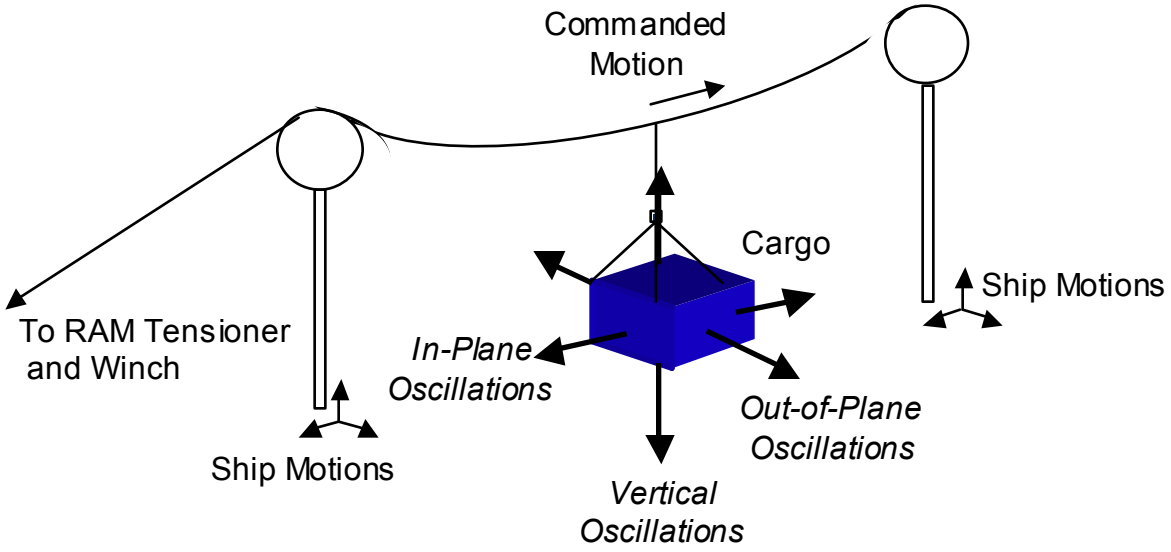
Agenda

- Motivation / Objectives
- Approach / Benefits
- Methodology
- Summary

ExLog FNC Objectives

- Decrease UNREP time by 50%
  - Double transfer speed?
  - Double cargo size?
- Double vessel separation?
- Perform UNREP in Sea State 5
- Decrease UNREP manning by 40%



Objectives / Approach

Analysis Objectives:

- Characterize and evaluate dynamic performance
- Develop UNREP system performance requirements to satisfy FNC Objectives

Analysis Approach:

- Computational M&S of baseline and proposed UNREP systems in realistic operational environments
- Challenge:

No pre-existing simulator can model the entire system!

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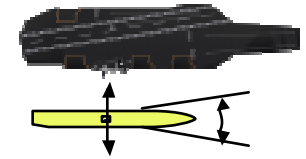
Approach

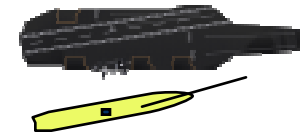
- **Basis: Crane ATD Simulator**
  - Time-domain, force-based
  - Multi-Spectral, Multi-Directional seas
  - Multiple Coupled Vessels
- **Create simulation-based test bed**
  - Coupled Multivessel Maneuvering
  - Coupled Multivessel Seakeeping w/ forward speed effects
  - CONREP System Dynamics

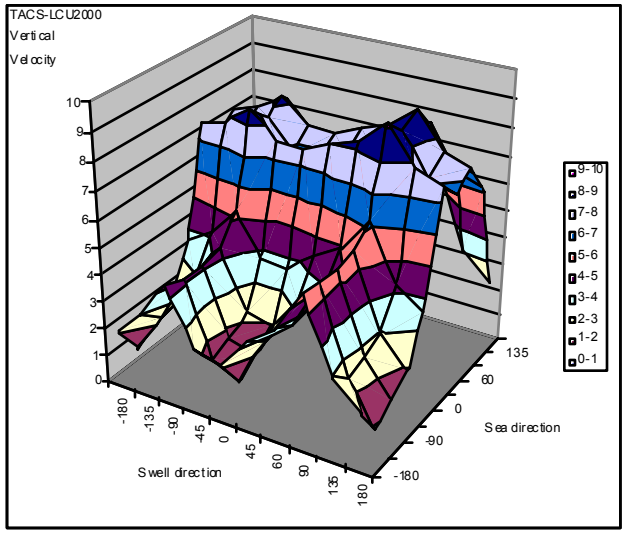
=> Integrated, Standalone Analysis Tool

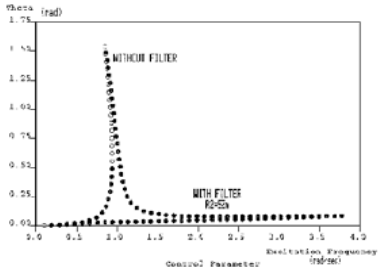
Benefits

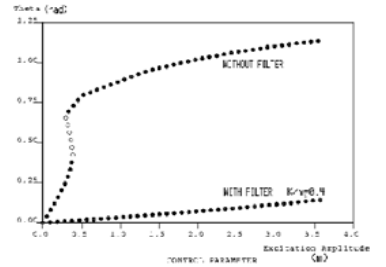
- **Enables simulation-based assessments:**
  - **System Characterization**
    - **Baseline**
    - **Proposed**
  - **Requirements Analysis**
  - **Collision-scenario investigation**











Usable at 3rd Party Sites

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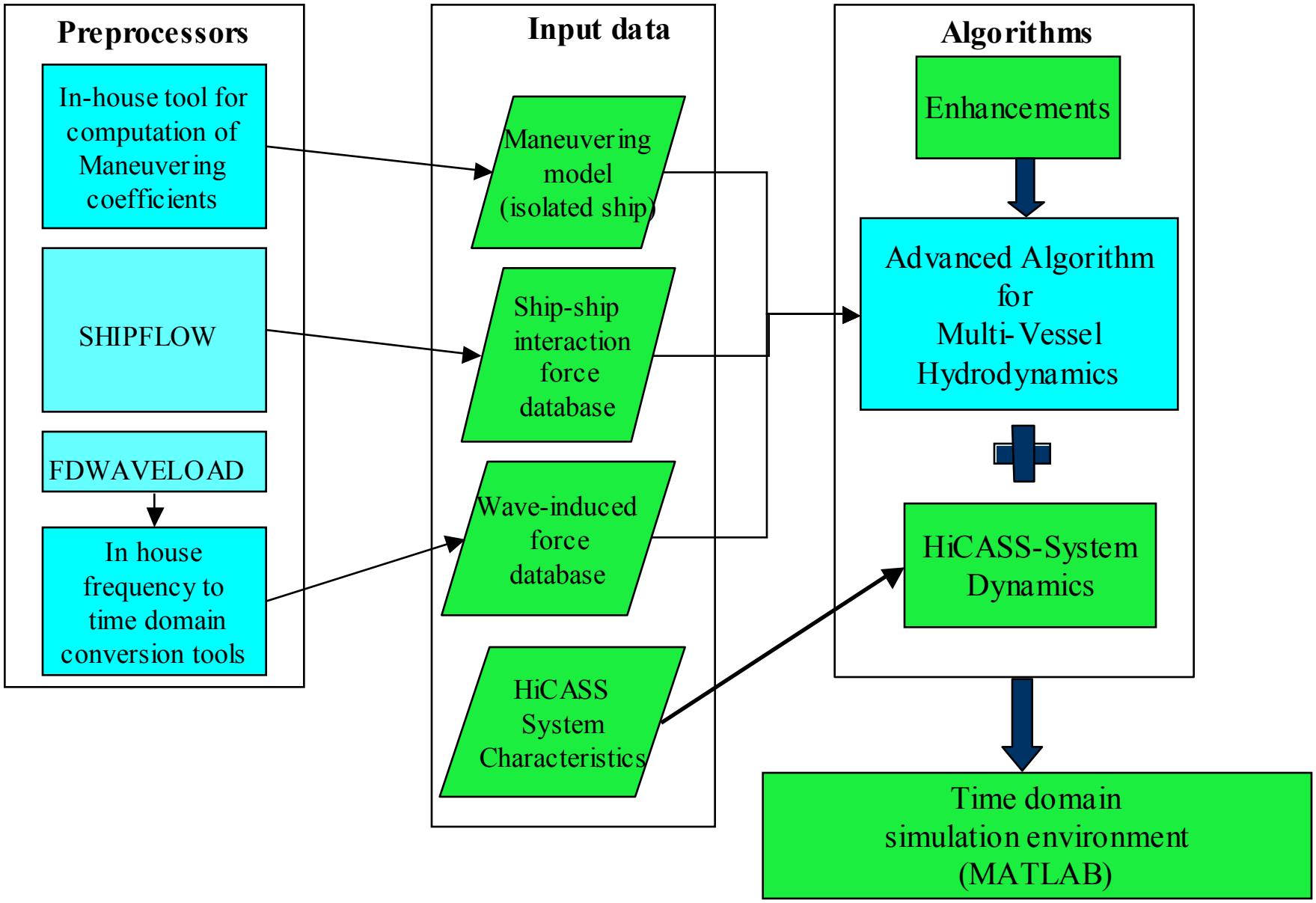
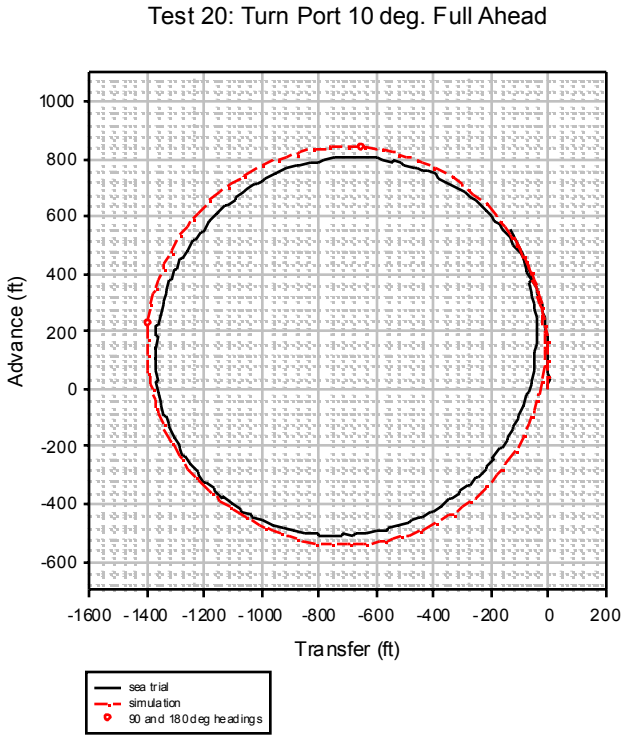
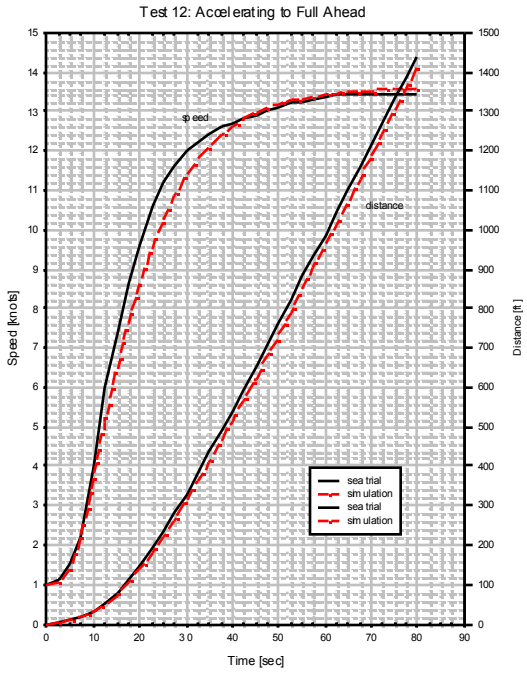
Methodology



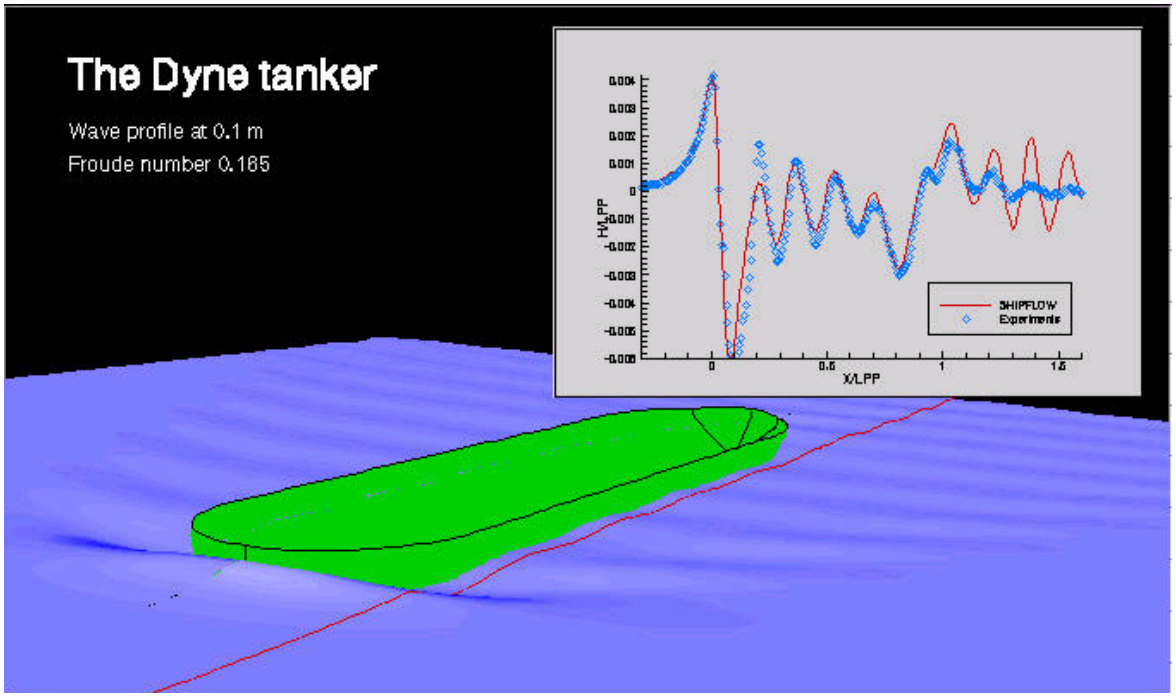
Maneuvering Forces: AgileShip™

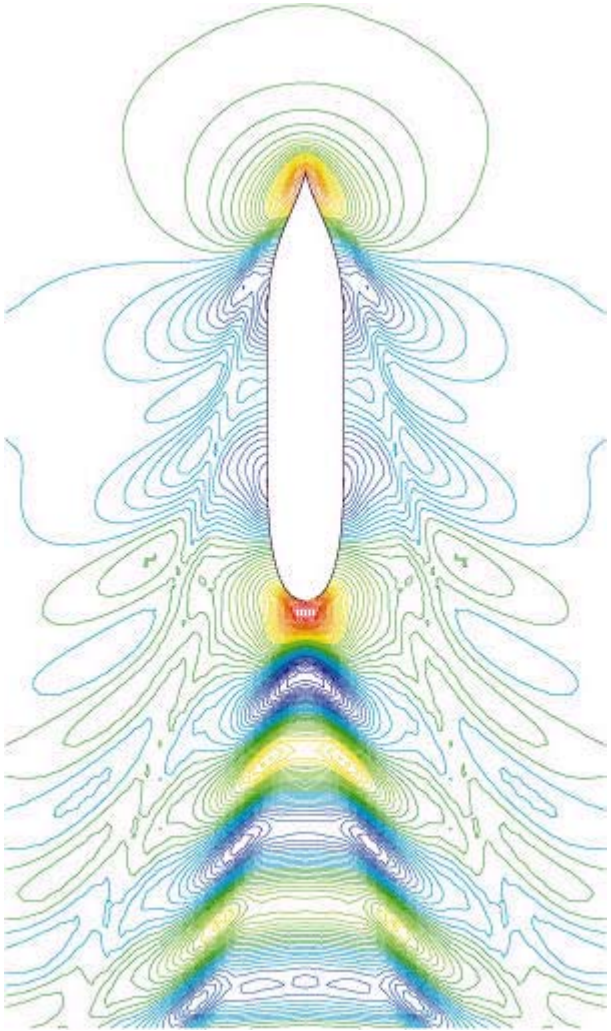
- **Isolated Vessel in Calm Water**
  - **Use standard in-house procedure**
  - **Validate against available ship and trials data**





Ship-Ship Interactions: SHIPFLOW

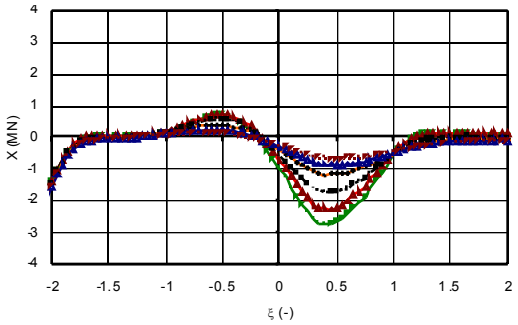


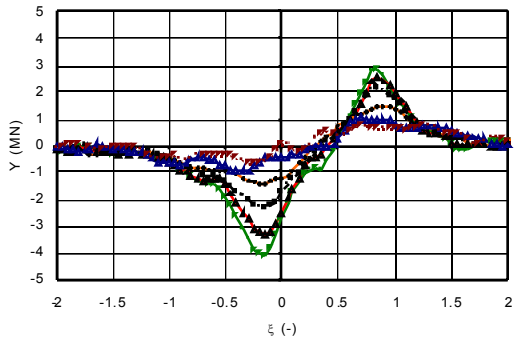


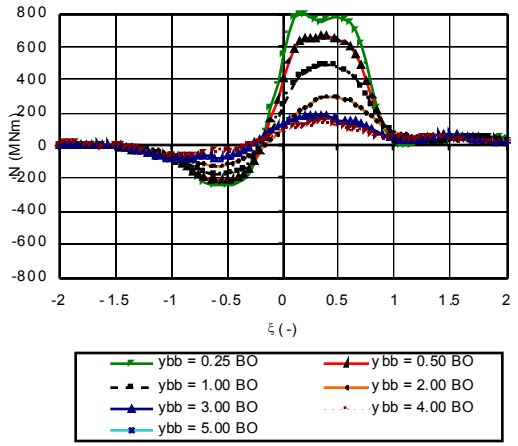
- Develop database of multivessel configurations
- Compute pressure induced by other hull
- Integrate to obtain interaction forces and moments

Ship-Ship Interactions: SHIPFLOW

- Compare method to model tests conducted at Ghent University, Belgium

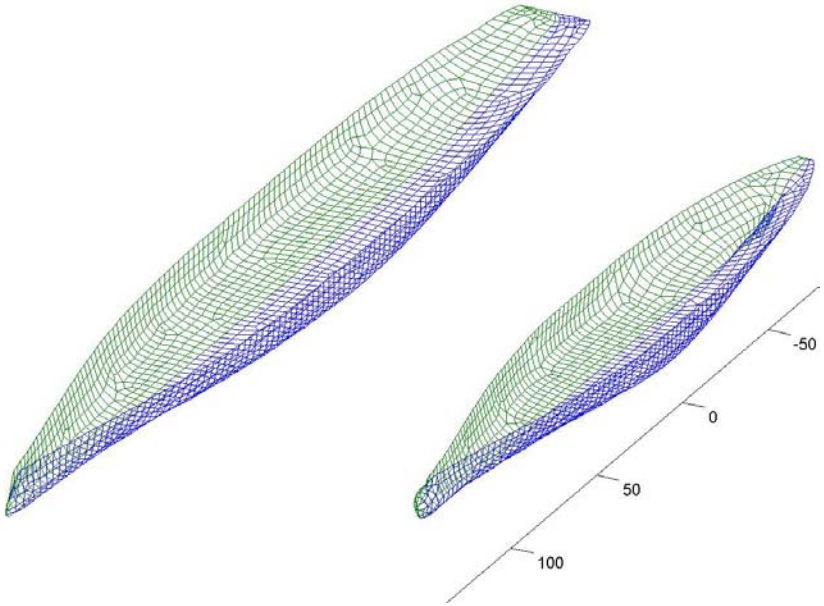


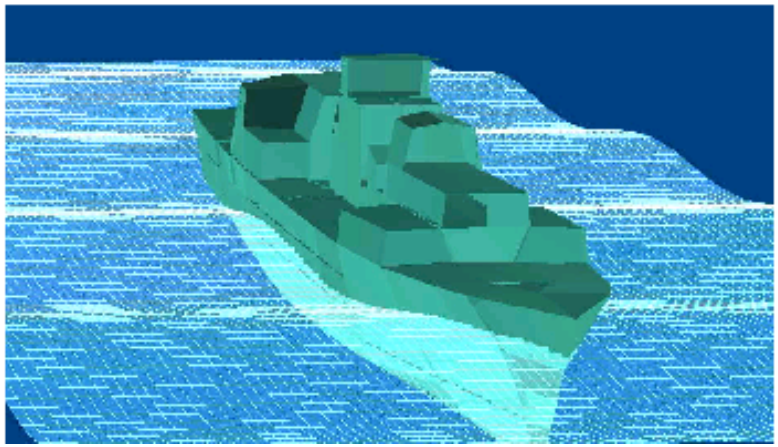




Seakeeping Forces: FD/Waveload

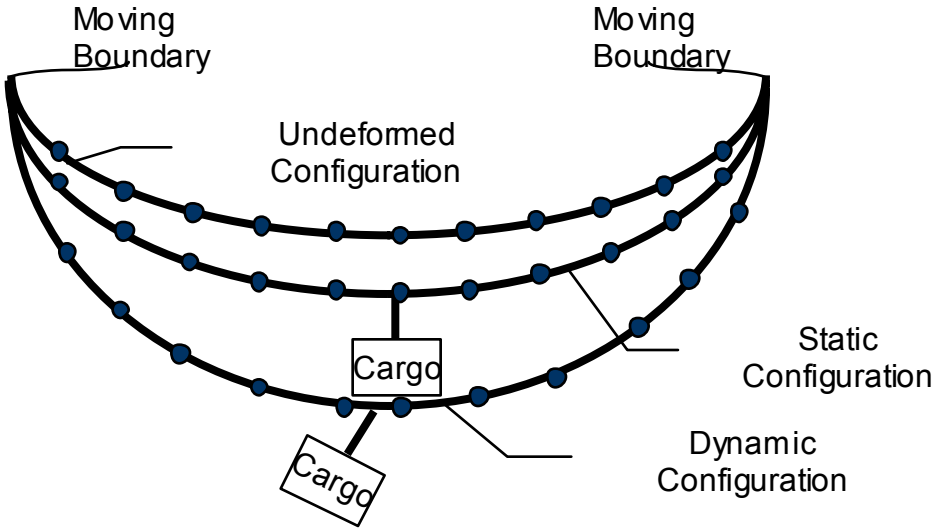
- Develop database of multivessel configurations
- Transform from frequency-domain to time domain using CSC-developed code

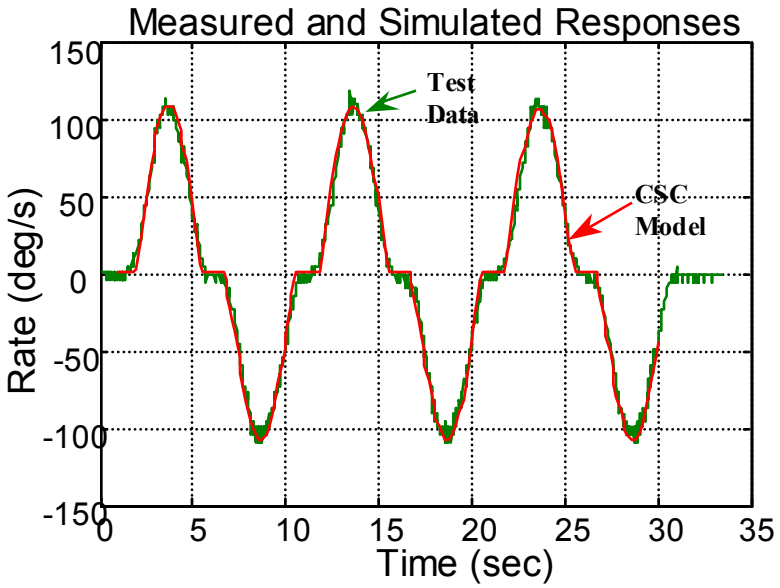




CONREP System: Nonlinear Finite Elements

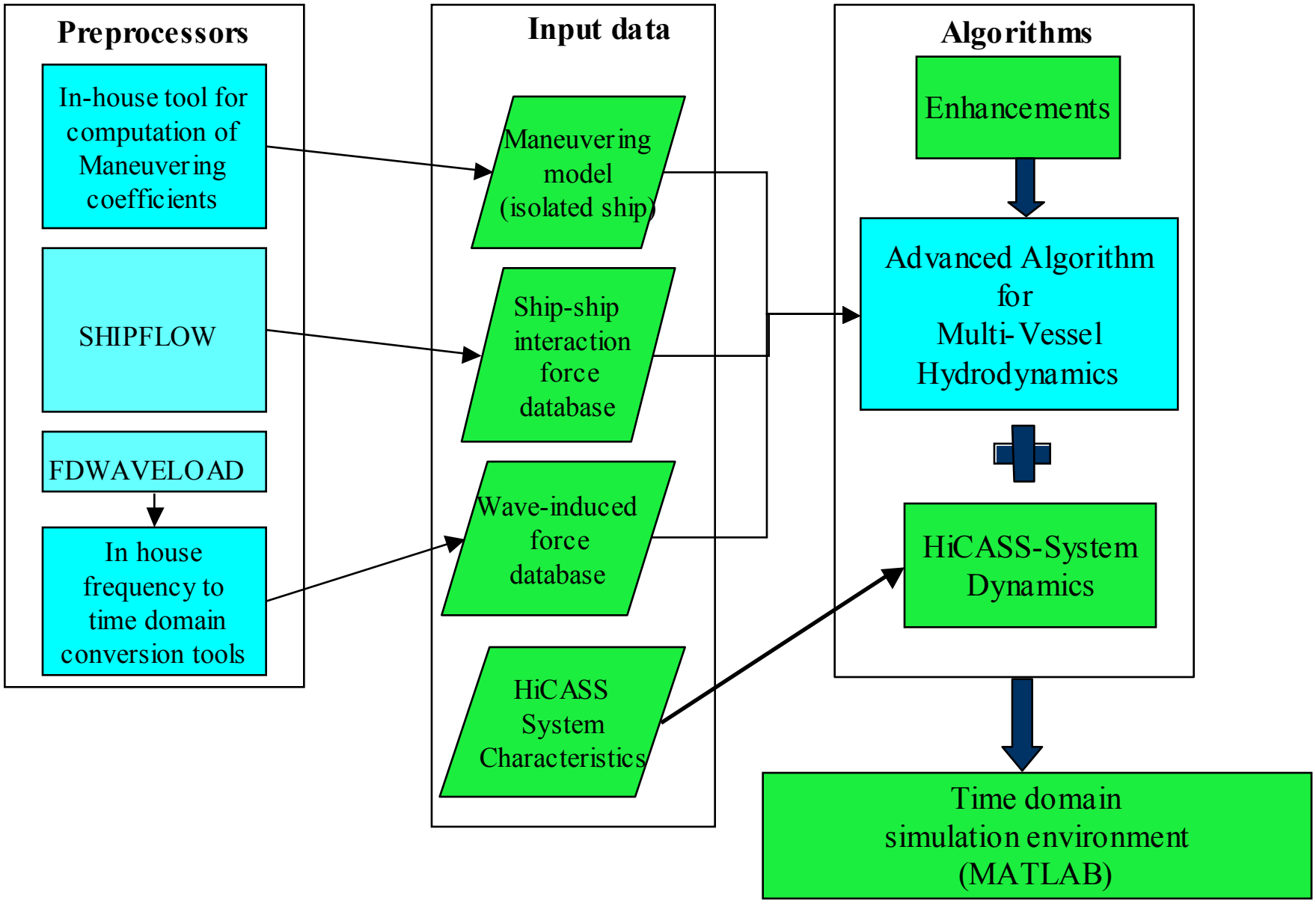
- **Lumped-mass discretization**
- **Compare to analytical solution (University of Maryland)**





- **Add machinery dynamics models of drive systems**
- **Can introduce any cargo handling system**

Methodology



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Summary

- Developing force-based, time-domain simulator for
  - Multivessel maneuvering and station-keeping in a seaway
  - Intervessel cargo handling
    - Initially modeling UNREP system
    - Extensible to any cargo handling system
- Supports HiCASS System Development
  - Requirements evaluation
  - Baseline and Proposed System Characterization
- Deliverable to 3rd party sites
- Available 1st quarter, CY04


Exercise: 'AOE CVN 1' Time 0.0 Playback speed 0